The Glass Industry
REG. U. S. PAT. OFF.

Vol. 15 FEBRUARY, 1934 No. 2

GIGANTIC STEEL CONDUITS FOR BOULDER DAM

X-Ray Tubes of Pyrex Glass Used in the Vitally Important Work of Structural Examination

By R. G. Skerrett

BOULDER DAM is now rising steadily from the depths of the canyon through which, for untold time, the Colorado River has traced its more or less torrential course. When the dam mounts to its ultimate climax, 730 feet above the bed of the stream, then that structure will create a reservoir 115 miles long and capable of impounding virtually the whole flow of the river during a period of about two years. That means that the basin will hold, when filled, the tremendous total of 30,500,000 acre-feet of water—equivalent to nearly 10,000,000,000,000 gallons. Choose whichever of these figures will be the more understandable. Expressed in another way, that quantity of water would be sufficient to cover the State of Connecticut to a depth of 10 feet

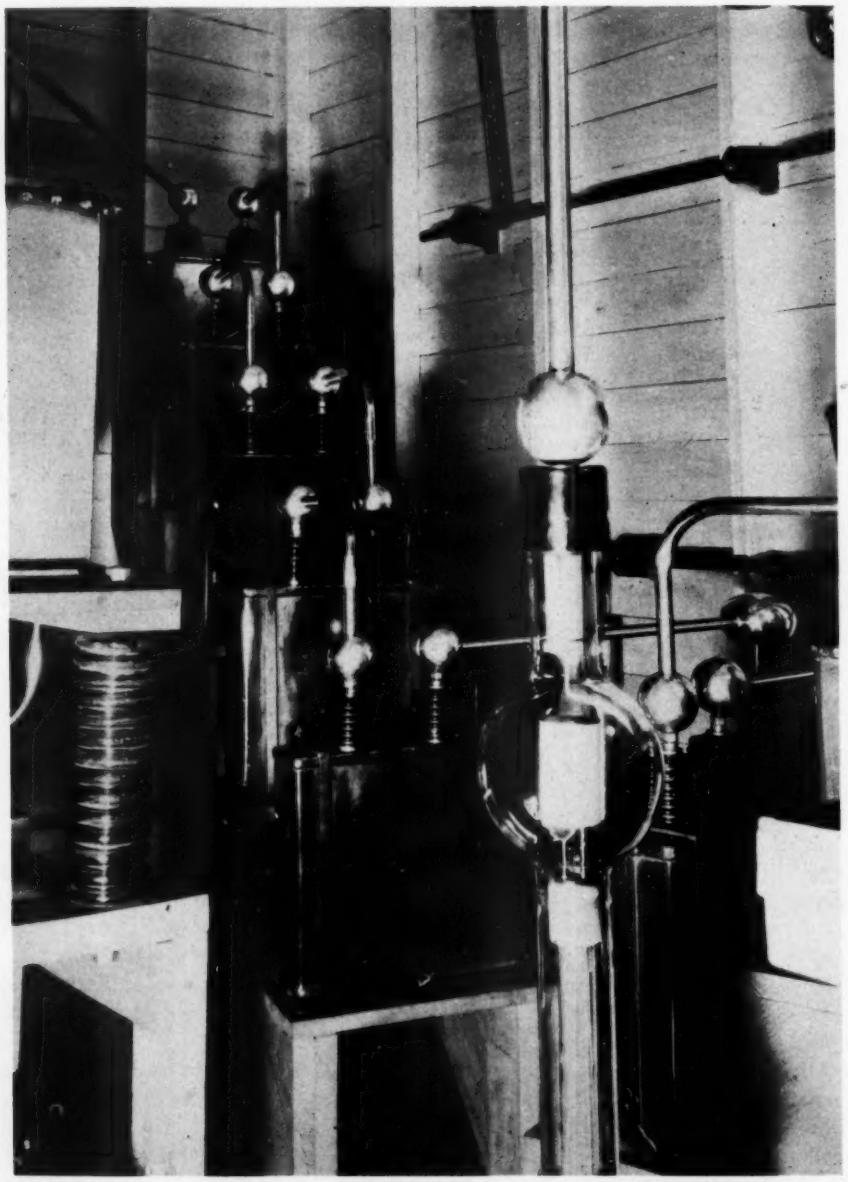
The Boulder Dam will perform only one of the several services for which it is being reared when it puts an effectual check on the destructive flood periods of that river of widely varying volume of flow. The dam will perform the other important functions of maintaining a reasonably uniform flow in the river the year around so that the farmers and orchardists of irrigated lands may be sure of an ample supply of water even in the ordinarily low-flow months of every year; and, finally, to insure a compensating revenue, the water released from the reservoir and returned to the river below the dam will be used to drive great hydro-electric units that will ultimately number seventeen and have a combined capacity of more than 1,800,000 horsepower. Contracts have already been signed for the purchase of this electric energy; and in the course of half a century, the sale of this current will more than pay for the entire project.

Except when the reservoir is filled to overflowing and the excess water shall escape through two enormous spillways emptying into two tunnels each 50 feet in diameter, all other water discharged into the river from the reservoir will do so by way of a system of steel conduits of unprecedentedly large dimensions. The system will consist of four major divisions that are to be linked with four monumental intake towers, each about 390 feet tall; and the connecting pipe will be 30 feet in inside diameter, with long terminating sections 25 feet in diameter. Branch mains, 13 feet and 8½ feet, respectively, in diameter, will lead off from the monster mains and carry water to the turbines or to four groups of outlets—the discharge into the power plant or from the outlets being controlled by balanced valves of notable sizes. All the conduits will be hidden away in tunnels that have been driven through the rocky walls of the canyon on each side of the river. When the reservoir is filled, the level of the water will be nearly 600 feet above the turbine nozzles or the other outlets; and at the lowest operating level the water driving the hydro-electric units will have a head of not less than 420 feet.

One does not have to be versed in hydraulics to realize that exceptionally high pressures are exerted on pipe walls and control valves of such an installation; and every part of the system will have to be strong enough to confine securely disruptive stresses of extraordinary magnitude. Therefore, the experts of the Bureau of Reclamation, after much research and laboratory tests on an unusual scale, decided to adopt steel conduits for the water-regulating system—whether leading the water to the turbines or back to the river to maintain a given volume of flow below the dam. No pipe has heretofore been manufactured as large as most of the sections mentioned, and none approaching such sizes could be produced at any industrial center and then transported by rail to Boulder Dam—bridges are too low and tunnels are not large enough to permit passage. Accordingly the conduits are being conducted in a unique shop, splendidly equipped, that has been established in a desert region of Nevada and close to the Boulder Dam. This epoch-marking work is being done by The Babcock & Wilcox Company, a concern that has long been engaged in building steam boilers and pressure vessels for many different industrial services.

No matter whether the pipe section be 8½ feet in

diameter or 30 feet in diameter, each is made by bending plates and then uniting them by fusion welding so as to form a cylindrical section. The plates are shipped flat from the steel mills in the Middle West, and after reaching the shop at Bechtel, Nevada, they are run through powerful bending rolls and given their required curvatures. The lightest of the plates are 5/8 inch thick while the heaviest of them are 2¾ inches thick, and they are rolled cold—hence the bending rolls are of great power. Each plate used in fabricating the 30-foot diameter conduits is about 32 feet long, 12 feet wide, and 2¾ inches thick. Two such plates, having a combined weight of 46 tons, constitute a carload; and six of these plates are joined together to form an erection section 24 feet long. These particulars will help to a realization of the weights and sizes that must be handled; and an erection-section, 24 feet long and 30 feet in diameter, will weigh about 140 tons when moved from the shop to the rim of Black Canyon preparatory to lowering it five hundred feet or more before carrying it into the tunnel where it is to be placed.



TYPE OF POWERFUL X-RAY TUBE NOW BEING USED TO RADIOGRAPH FUSION-WELDED STEEL CONDUITS FOR BOULDER DAM. THE X-RAYS CAN PENETRATE SIX INCHES OF STEEL, AND PRODUCE A SHARPLY FOCUSED RADIOGRAPH.

The opposing edges of every welded seam are machined in the shop to form a narrow groove into which the welding metal can be deposited gradually so as to fill that groove from end to end with steel and thus firmly unite the two edges. That is to say, the weld, itself, must be fully as strong if not stronger than the plates that are bound together. This

goal has been reached only after years of patient experimenting and continual improving of means and methods. This is understandable because the process was primarily devised to facilitate the fabrication of vessels designed to meet high internal pressures of some hundreds of pounds. Any yielding would probably lead to serious damage, if not disaster.

The Babcock & Wilcox Co. are using on the Boulder Dam conduits automatic electric welding machines that do their work rapidly and with great uniformity. The electric arc melts steel rods that are fed steadily into the flame as the machine progressively deposits a layer of metal along the length of the seam; and because the rods have an envelope or coating of slag, the slag melts at the same time and spreads a film over the freshly deposited molten steel. The film excludes the air and thus prevents the fluid metal from absorbing either oxygen or nitrogen, which might impair the physical characteristics of the weld. Before the next layer of metal is deposited in the upbuilding of the weld mass, the film of slag is easily fractured and brushed away —the underlying metal then being cold and solidified and offering a bright surface on which to lay the next "bead" of weld metal. In the end, a weld of strong, fine-grained metal is produced, and outwardly the weld has an excellent appearance in all respects. But the contractor is more concerned with what may lie within the mass of a weld, because he knows that deep-seated defects may lead to breakdown or failure under repeated stresses, and he insists on discovering any such lurking imperfections. Here is where the glass industry plays a vitally important part either in dispelling doubt or bringing to light any inclusions in the deposited metal that may be the source of an immediate or a possible structural weakness. The X-ray tube is used to make this searching examination and to register the internal condition of every inch of every foot of welding.

The tubes that are employed at the Bechtel fabricating plant are of unusual power, and they are capable of sending their revealing rays through steel that is quite 4½ inches in thickness. However, they are not required to penetrate more than 2¾ inches of steel in examining the deepest or thickest of the welds on the largest of the conduit sections. A radiograph of such a weld can be made by an exposure of 20 seconds, and records of shallower welds can be made in a much shorter time. The X-ray tubes are 4 feet long with a bulb 8 inches in diameter, and the tube is of Pyrex glass with walls ¼ inch in thickness. Electricity at the great pressure of 300,000 volts and a current of 10 milliamperes is fed into one of these tubes to produce X-rays that will register a sharply focussed image of a weld mass at a distance of 30 inches. The rays are concentrated upon the near side of a weld by a cone of sheet lead, and the rays then pierce the mass of the weld and affect the recording film which is exposed on the farther side of the weld. In this manner, extremely minute imperfections in the weld are made visible

ONE OF THE PORTABLE X-RAY MACHINES IN SERVICE AT THE BECHTEL, NEVADA, PLANT OF THE BABCOCK & WILCOX COMPANY. THE APPARATUS IS MAKING A RADIOGRAPHIC FILM OF A WELDED CIRCUMFERENTIAL SEAM.

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The Rejuvenation Of Raw Lime In Glass Making

I BELIEVE that some time around 1915 I "put my foot in it" by strenuously advocating the use of raw lime in the making of soda-lime, so called flint glass, and the censure and criticism which was directed towards me because of the failure of a number of plants to obtain the results I had predicted by the use of raw lime was sufficient, to say the least, to effect a rather prejudiced, biased and perhaps distorted viewpoint of the situation. However, I think that present conditions, to a great degree, justify the stand I took at that time and my praise of the use of raw lime in the making of all types of containers, lighting ware, and flint glass.

My object in presenting my views at this time may be considered as being an "I told you so", but such is not the case. The real object is to, if possible, bring home to the lime and glass manufacturers, alike, the error that was committed at that time and the results which are now being obtained by what I advocated and so earnestly preached; i. e., the getting together of the technicians of both sides and determining specifications which could be met by the lime suppliers that would fulfill the requirements of the glass manufacturers with the hope that they will profit by past experience.

It is gratifying to see now several glass manufacturers again adopt the use of raw lime and to me it is truly a great satisfaction to realize that at last the lime manufacturers, one or two at least, have come to recognize the fact that it is not such a terrible job nor such a harrowing and disconcerting task to select, grind and classify good, clean rock and ship it as a real chemical product for glass making; a condition which they apparently would not recognize (or at least they did not) create and carry out, for if they had applied one-half the care and attention in producing glass makers limestone that they now exercise, they would have not only reaped large financial benefits, but they would have advanced the glass industry and the economy of glass making to a marked degree.

It seems almost impossible that it took the lime manufacturers nearly twenty years, if the facts are any criterion, to put into effect methods of operation and quarry conditions that would enable them to supply the glass manufacturer with good, clean stone, washed, or at least freed from alluevial matter, faulty rock and inferior quality of stone, ground and classified to meet the specifications or requirements of the glass manufacturer. In those days the glass manufacturer merely asked the lime suppliers to maintain a uniform composition of stone or, to put it another way, to supply them with rock from a given ledge or seam only, then to classify or screen it to suit their requirements found in their very elastic specifications. The most they asked for was that it should be uniform, with a suggestion or request that the stone be kept as free from smoke, soot, coke, ashes, alluevial matter, iron and dirt generally, *as possible*.

While I do not profess to be well informed at this date concerning the exact procedure in the various lime plants, I am informed that a person can now obtain a clean stone, unadulterated with any of the above harmful constituents, and submit his specifications concerning grain size and iron content and have his orders filled promptly and up to his specifications. If I am correctly informed and my observations are anything like correct, the lime manufacturer or supplier has suffered very little and incurred a very small outlay, nor has he very materially changed his plant operations to meet present specifications. One cannot help but marvel and wonder and ask, "Why didn't they do it long ago? What enables them to do it now?" Surely not price.

One cannot put all the blame on the lime people for it is quite true that the glass manufacturer was not always consistent in his requirements and demands, nor was he always justified in the "kicks" he made, nor was the lime always to blame for his bad results, but what I do say and firmly believe is that the fault, if it can be called such, lay in the obdurate, prejudiced and stubborn attitude of the lime manufacturers, coupled with a lack of specific knowledge on the part of the glass manufacturer as to the actual difference in results between raw lime and burned lime.

Now during the period of business recovery, particularly the glass business, with the promising possibility of large requirements on the part of breweries and distilleries and the more critical requirements of these concerns for their containers, it would seem to be a propitious time again to agitate and endeavor to get the technical men of these two industries to collaborate with the view and object of each fully understanding the other's party situation.

If this is to be done, for Heaven's sake let both sides forget their old qualms and fears that each will learn something about the other's methods and costs, which, if my memory serves me correctly, was the principal if not the fundamental reason for its taking nearly twenty years to part the veil that each can see the other's limitations and possibilities. Therefore, isn't it about time, if not the correct time, for a joint meeting to establish specifications and a harmonious collaboration.

I have always said and still maintain, and I think it is amply proven, that pure, raw lime, free from extraneous matter, carefully mined and classified will make a better glass, at less cost, more uniform in its properties, (a factor of paramount importance to all of those using feeders) a greater uniformity of product, operation, distribution, color and resistance to solution, bloom, fading, cords, strings, seeds, blisters, and practically all of the imperfections the glass container or other kinds of glassware has been heir to.

As I think of this situation I recall an instance that is amusing but rather sinister. A glass manufacturer switched from burned to raw lime and in the beginning had very little trouble. The glass was satisfactory but some of it was stored and shortly after the storing of considerable quantities of this glass, the manufacturer learned that the lime supplier was sending him for his glass making the same product he was sending him for fertilizer on his farm. On opening some of the packages stored in the ware house he found a vast number of the containers coated with a fern-like growth, upon

which he remarked, "It is no damn wonder that it was growing ferns inside my bottles when that lime supplier made a mistake and sent me agricultural lime."

But let us hope that such substitution is a thing of the past and that the lime manufacturer now recognizes that the product he sends to the glass manufacturer is just as much a chemical of importance as is his wife's baking powder or cream of tartar. R. FRINK.

Glass Chipping

By C. EARL AVERY

ELABORATE equipment is unnecessary for the production of glass decorated by the chipping method. In fact, amateurs have been known who turned out first-class examples of chipped glass with no equipment whatever, excepting a glue pot and brush. But inasmuch as the chipping was done by the sun, some heating equipment is recommended, no matter how crude.

Chipping glue is usually applied to the glass while in a molten state, allowed to cool and then reheated to 200 degrees Fahrenheit in a kiln or oven. When the glass is removed from the oven and set on edge in racks in a cool place, the actual chipping occurs. The glue curls and peels as it dries and contracts, and takes splinters of glass along with it. These dry splinters of glue and glass can be remelted and used again.

The result is an uneven, semi-transparent surface on the glass which can be enhanced by a second application of glue and a subsequent chipping process. A finer pattern is produced—a pattern of fine veined leaves not unlike frost on the window pane.

Chipping glue, first soaked in water, then melted, can be reduced to a molten state in either a glue pot or a double boiler. The latter can be cheaply made by inserting a galvanized pail into another pail which contains the water. Glue should never be melted over a direct flame. If the glue is soaked over night before melting it will work better. It is applied while warm to the glass.

If a kiln is not available for heating the glue-covered glass, a small room can be made of lumber or canvas in which a heater, not too large, yet large enough to produce the required 200 degrees of heat, is placed. The glass should be set on edge in a rack, especially where space is at a premium. It can be left in the room for several hours to assure its taking the proper heat. If canvas is used for walls, it is advisable to do the heating in daylight to insure against possible fire.

Line borders, designs and lettering are first made by pasting heavy paper over the glass and cutting out the part to be chipped with a sharp stencil knife. Design can be transferred to the paper covering the glass by various means. If a needle or similarly pointed tool is run around the edges of the design, where the glue overlaps the protective paper covering, while the glue is setting it will tend to produce a sharply defined line which shows in the finished piece as a clean-cut outline around the design.

Effective chipped glass signs can be made by applying the lettering backwards, so that the sign will read from the face of the glass. Background or message can be chipped and gold leaf or colors can be applied to the chipped or plain surface.

Transparent colors carefully applied to the chipped portion of the sign make sparkling night signs when lighted from the back. Unusual effects can be obtained by chipping the lettering, leaving a clear outline around the letters and applying transparent colors to them. The addition of gold leaf to the background, which is separated from the letters by the outline, will enhance the effect.

Combinations of chipped glass, acid etched glass and sandblasted glass in either or all of the combinations can be used with telling effect, for signs or displays. Still another effect can be had by first sandblasting the design deeply into the glass, then chipping it.

Glass chipping is not confined to plate glass. It can be done on single and double strength, sheet, opal and other types of glass. Some excellent examples of chipping have been noted on flashed glass, the work being done from the flash side. The inexpensiveness of the chipping process makes it adaptable to many uses. In addition to the usual application on office doors and partitions, counter screens and the like, it has been decoratively used on mirrors, desktops, window valances, show window backgrounds, lighting fixtures and art novelties.

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and their exact positions indicated so that the faulty metal can be cut out, that section refilled, and the new metal X-rayed to make sure that it is absolutely sound. The new tubes, because of the glass used and certain associate improvements, is not only more powerful than those made heretofore, but they can be operated at maximum capacity over a much longer period of service. The value of X-ray inspection is not likely to be exaggerated because it reveals vital knowledge surely and quickly that cannot be obtained otherwise in a way to meet manufacturing conditions. If the X-ray indicates that a weld is a sound one, the crucial point of production is passed. The subsequent tests and treatments given an erection section before removal from the shop merely supplement the findings of the X-ray and have to do with other physical characteristics of the work.

Before the last of the conduit sections has been fabricated, the shop at Bechtel will do 400,000 linear feet of welding, and the X-ray tubes will radiograph each and every foot of all that welding. The magnitude of the task of fabricating 14,500 linear feet of the great pipe, making sure that all of it can meet the rigorous specifications, and then assembling all the sections in the different tunnels, will make it understandable why the contractor is to be paid the sum of $10,908,000.

British Evolve New Art Process For Glass

REMARKABLE success has recently been achieved in the evolution of a new process of a mechanical and chemical character by which artistic designs of any kind can be reproduced on glass.

The designs are reproduced on mirror glass and any subject can be faithfully portrayed down to the most minute detail. The main feature is the coloring. While at present most of the work is of an advertising character, developments are taking place, and it is possible that in the near future the process will be applied to the reproduction of highly artistic work for interior decoration. Experiments have shown that landscapes, pictures of buildings, and portraits can be faithfully reproduced in natural colors. The designs are transluscent and can be made very effective at night by placing lights behind the glass.

In order to test the accuracy that can be attained by the process the inventors have experimented with a highly intricate coat of arms, and were successful in reproducing every detail. This reproduction has been highly commended by the College of Arms, London. It is possible that there will soon be on the market public school and college mirrors, bearing the appropriate crests; while the industry may be further extended to the production of decorative wall mirrors and to framed portrait mirrors. It is claimed for the process that not only does it ensure accuracy and delicacy of color but permanency of design.

A highly important new industry may arise from this discovery.

New and Unusual Uses of Glass

Mr. A. C. Marshall of New York, consulting engineer for the Corning Glass Works and president of the American Institute of Chemical Engineers described new and unique uses for glass developed in the laboratories of the Corning Glass Works, at a lecture given in the Franklin Institute, Philadelphia, January 11.

He gave several interesting demonstrations, some so new in development that this was their first introduction to the public. Among the new developments is a tin can with a glass top and bottom, developed in the Corning laboratories. Soon housewives will be looking at the ends of a can of produce they buy to get a glimpse of the contents.

Mr. Marshall described the change from a three-component material, composed of silica sand, soda and lime to a five-component material consisting of the first three with small amounts of magnesium and aluminum added.

In an article by Laura Lee in "The Philadelphia Evening Bulletin" it is stated that:

"Mr. Marshall also believes that a most important future use of glass will be in windows in air-conditioned homes and offices. Ordinary glass lets through too much radiant energy, heating the room, which makes running the conditioning plant difficult and expensive. The new glasses made with borax absorb the infra red rays at the heating end of the spectrum.

"A Joe Cook kind of apparatus was a wind-mill gadget set in motion by a beam of light (radiometer, to scientists). A red glass held in front of the beam allowed the machine to go on revolving. A certain, blue-green glass, however, slowed down the movement considerably. Radiant energy passed easily through the red glass, while only a small amount went through the green.

"A piece of heat-absorbing, heat-resisting glass through which ultra violet light can pass, but not the visible infra red rays, stopped the radiometer wheel entirely.

"A glass so opaque you could not see through it nevertheless allowed so much heat to pass through, the beam of light set fire to a piece of paper held in its path."

"Also on exhibit was glass which contained 30 per cent lead, yet was transparent. These lead glasses are important in handling X-rays.

"There were great glass spools used in artificial silk making, preferable to metal because of their chemical resistance and ease in cleaning, pictures made of miles of glass coils used in the acid industries and little glass vials used to contain insulin and salvarsan. The alkali of ordinary glass is dissolved by these chemicals, converting them into strong poisons.

"A radio glass insulator which Admiral Byrd carried to the North Pole lay next to a piece of brown glass from Ninevah, 625 B. C. The latter was excavated with a clay tablet on which were the instructions for making the glass not very different from those used until recently, except in the ancient days, there were prayers and certain times of the month propitious for glass making.

"Glass and people often fail for the same reason, stress and strain. With a projection lantern and polarscope (instrument devised for testing strain in glass, not people) Mr. Marshall threw on a screen glass that had been subjected to strain from heating. Beautiful color effects appeared which tell the scientist the whole story effects which would certainly thrill an artist.

"He also showed a glass spring with considerable elasticity. A man in the audience thought it could be used for unusual lighting effects. I myself think it might make a good bed-spring. Sanitary, anyway.

"Glass goblets of the future will be a joy to the housewife with a careless maid. The goblet will bounce instead of break. Also, it seems, the pots and pans of the future will be made of glass. But not the houses, thinks Mr. Marshall, though they may contain a large proportion of glass."

Amber Glass

Lead glass may be given an amber color by the use of selenium, under oxidizing conditions. Borax helps to bring out the color, and improves the brilliancy of the glass. Selenium amber plains easily. In this respect it is superior to

carbon and sulphur amber glasses, which have a tendency to foam, and are difficult to obtain free from seeds. Since lead amber glass cannot be made with carbon and sulphur, selenium is a convenient material for the production of high grade amber tableware.

New Tour at Toledo Museum

The Toledo Museum of Art, Toledo, Ohio, has arranged a new 15-minute tour of the galleries which covers many interesting examples of the glassmaker's art. The examples are from the collection of Edward Drummond Libbey, formerly president of the Owens Bottle Co.

Irridescent ancient glass, jewel-like in its flashing colors, fills an entire case in the classic court. The tints of the objects in this group are the result of chemical reaction because of burial or exposure to elements.

Glass Phase In Fired Clay Material.

At the Columbus station, in the study of the glass phase in fired clay materials, a number of glasses have been prepared in the 4-component system $K_2O.CaO.Al_2O_3SiO_2$. The surfaces of the tetrahedron representing this system are composed of the following 3-component systems: $K_2O.Al_2O_3.SiO_2$, $CaO.Al_2O_3.SiO_2$, $K_2O.CaO.Al_2O_3$, and $K_2O.CaO.SiO_2$, all of which are of ceramic importance. Glasses whose compositions are represented by points within the tetrahedron are formed whenever mixtures such as flint, feldspar, whiting, and china clay are subjected to high temperatures. A knowledge of the properties of all these glasses in the tetrahedron would be of considerable value to ceramists.

At present the portion of the tetrahedron lying between the 50 and 80 percent silica levels is being investigated. A preliminary study, using cones, was made to obtain some idea of the fluidity of these glasses. The raw materials used were potters' flint, calcium and potassium carbonates, and hydrated alumina. Two fusions were made of mixtures of these raw materials in the proper proportions. Each fusion was followed by a fine grinding of the mass in order to produce a homogeneous glass. The pulverized glass was then moistened with a solution of gum and molded into standard sized cones. These were fired in a muffle furnace, and the temperatures at which they deformed were noted. Two refractory areas were found in the 50 percent silica level: one at 20 to 25 percent K_2O, 5 to 10 percent CaO, and 15 to 25 percent Al_2O_3; and the other at 5 percent K_2O, 15 percent CaO, and 30 percent Al_2O_3. Two low melting areas, one high potash low alumina, the other at 5 percent K_2O, 20 percent CaO, and 25 percent Al_2O_3, were found. Both the refractory and the low-melting regions extended (as volumes) up to the 60 percent silica levels.

Those glasses were selected for further study which were not (1) too refractory to be fired at a temperature limited by the deformation of the container, a high alumina clay crucible, nor (2) too corrosive due to high lime content, nor (3) too hygroscopic due to high potash.—*Technical News Bulletin.*

New Art Mirror

Dr. Alexander Silverman, Head of the Department of Chemistry, University of Pittsburgh, announces the acquisition of a new art treasure for his already famous glass collection. The design of an old glass furnace of the sixteenth century, based on a cut in "De Re Metallica" by Agricola, published in Basle in 1556, has been used as a motif by Mr. Albert W. Varasse, an artist employed by the Pittsburgh Plate Glass Company; this design was etched

on the underside of a sheet of plate glass, 25" x 53" in size, in the company's plant, and then backed with a gray mirror. Mr. Varasse has applied a Saracenic scroll above and below

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Glass Industry

ESTABLISHED 1920

The First Trade Journal Devoted Primarily to Glass Technology, Engineering, Raw Materials and Glass Factory Equipment and Operation

PUBLISHED MONTHLY

Copyright 1934, by

Glass Industry Publishing Company, Inc.

102 Maiden Lane, New York

Telephone BEekman 3—0474 Cable Address Glasdustry

G. W. Cooper, Managing Editor

Helen Glass, Business Manager

Subscription Price...United States $2.00 a Year; Foreign $3.00

Single Copy ..... 25 Cents

Bottle Breakage Complaints and Lawsuits

THE ultimate destiny of all bottles is to be broken. The pieces of a broken bottle convey no meaning to the average "man in the street". A bottler will return to the bottle manufacturer parts of a bottle, indicating that the bottle really is broken, and ask for an explanation, but may fail to send the vital parts of the bottle, namely those parts surrounding the point of origin of the fracture. Bottles are even introduced in lawcourts with the most important pieces missing. This makes it difficult to determine the exact point of origin and the exact cause, even from a technical angle; and if the law is going to hold, as it now threatens to do, that the bottler or bottle manufacturer must offer an explanation of the fracture, he may be in a position of absolute impotence unless the whole bottle is available for scrutiny.

When a bottle breaks it may break into a few or many fragments, but all the fragments are not formed simultaneously. A fissure starts at a single point and is propagated endwise in both directions. In either of these directions the fissure may fork. Secondary fractures may start at right angles from the original one, but they cannot form until the primary facture is already in existence. There may be a mass of equiaxed fragments, or slivers and spear points of glass. But unless the origin of the fracture can be located among the fragments, a great deal more uncertainty as to the exact cause must exist than if the origin can be found.

Bottles are rarely perfect; and yet they are usually a high grade commercial product. Considering the price, few things probably are better made. Yet in many bottles there are imperfections. Distribution is rarely perfect. It is characteristic of some bottle forming machines that they leave a "wave" in the glass. And blank moulds rarely chill the seam as much as they chill the rest of the periphery, so that seams are frequently thinner after blowing up in the blow mould. The mere existence of a visible seam would be held an imperfection in a lamp bulb or high grade tumbler.

In colored bottles, the color may be "off", it may even be streaky: and in colorless bottles the same streakiness is frequently found, though much harder to see. Yet the streaks are not necessarily "cords" having any influence on strength.

Stones are sometimes present in bottles. Inspectors or "packers" usually throw out all stones, but small ones occasionally escape his notice. If a bottle containing a stone breaks later on, it does not follow that the stone was the cause of the break. Two requirements are necessary. The fracture must pass *through* the stone, in which case the stone probably had something to do with the breaking, but not necessarily; and the fracture must begin *at* the stone and run *away* from it, in which case the stone was probably a principal source of the trouble.

When the fracture does not start *at* a stone, nor even run *through* a stone, the existence of the stone has nothing to do with the fracture. To argue, as seems to have happened in one instance at least, that a small stone was the sole cause of a fracture when the fracture itself ignored the stone, is like arguing that a false tooth in an engine-driver's head is a full explanation of a railroad smash, without attempting to prove any connection between the two.

Manufacturers must learn to insist that a casual connection between imperfections such as stones, irregularities of distribution, and so on, and breakage must be shown to exist before they can accept responsibility for the breakage.

Weekly Date Book for 1934

("Agenda pour Verrerie, Ceramique, Emaillerie")*

By Jacques Wolf

So far as we know, there is no exact equivalent in English-speaking countries of this little book in French, which is published at Brussels. Out of about four hundred pages, a hundred or so near the beginning constitute the date book in the ordinary sense of the word, a little space being allotted to each day of the week on the left-hand page and a blank page for notes being opposite to it on the right. After this, follows a brief synopsis of glass technology. There is some discussion of the nature of glass, the properties of batch materials, and methods of making glassware, together with a substantial list of books on the subject, especially those published in French and German. Necessarily the treatment is very brief, for it occupies only about fifty pages.

There then follows a somewhat similar treatment of the ceramic and refractory materials, including glazes. The last 150 pages are devoted to a miscellaneous collection of workshop data and chemical and physical constants. These

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The Preparation And Prosecution Of Patent Applications

By Charles W. Rivise, published by the Michie Company, Charlottesville, Va. 484+XXII pages. Price $7.00.

By A. D. Caesar

Philadelphia Patent Attorney

THE publication of Mr. Rivise's book for the first time provides all those interested in inventions and patents with a complete and dependable guide to the preparation and prosecution of patent applications. The book is indispensible to all those who would cooperate with their patent attorneys to the fullest extent in securing adequate patent protection. For it contains a veritable mine of accurate information lucidly and concisely expressed and very conveniently arranged for ready access. The worker in the glass industry will find much of direct application to his own particular patent problem. In fact, many of the examples selected by the author to illustrate his points have been taken from litigated patents in the glass industry.

The individual chapters are arranged in what the reviewer believes to be the best order. Chapters I and II deal with fundamentals without a thorough knowledge of which no one can hope properly to prepare and prosecute a patent application. The first of these chapters discusses the various methods of protecting an invention, the fundamental principles of patentability and validity and the factors which determine the scope of an issued patent. The features in this chapter which especially appeal to the reviewer are the terse, clear and accurate summaries of the principles discussed and the commendable discrimination with which the author has chosen his illustrative decisions. The second chapter sets forth the steps preliminary to the filing of an application and lays down a number of simple rules for analyzing an invention and ascertaining its true scope.

The actual preparation of the application itself is covered by Chapters III to VII. These chapters successfully maintain the high standard set by the first two chapters. Chapter III deals with the application as a whole and discusses the formal details necessary to obtain a filing date. Specimen forms are given to serve as additional guides to the reader. Chapter IV is devoted exclusively to the disclosure and specification, while Chapter V deals with the drawing. These chapters are particularly valuable to specification writers and draftsmen, because of the large number of references to well prepared specifications and drawings. Illustrative excerpts are quoted from patent specifications covering many diverse industries involving chemical, electrical and mechanical principles. Two full chapters (Chapters VI and VII) are devoted to the subject of claims and present in an unusually orderly, exhaustive and understandable manner the rules and underlying principles for drafting every conceivable type of claim. A very large number of claims which have been scrutinized by appellate tribunals are quoted in full with a concise explanation of the principle of law involved. The author's treatment of broad chemical claims is worthy of special mention.

Chapters VIII to XII cover the prosecution of the application from its filing to the final issuance of the patent. The first of these chapters in addition to briefly discussing the functions and organization of the Patent Office, sets forth the circumstances under which an application may be made "special" and the rules upon which the Patent Office bases its requirements of division. Chapters IX and X discuss the examiner's action on the merits and applicant's response thereto. The latter chapter presents the various ways of amending an application after filing. Chapter XI treats of the various methods of overcoming the examiner's grounds of rejection. The different types of affidavits and what they should contain receive exceptionally full and adequate treatment. Chapter XII is devoted to the various ways of terminating the prosecution of an application as well as those for reopening the prosecution after it had been presumably terminated.

Appellate procedure within the Patent Office forms the subject matter of Chapter XIII, while Chapter XIV covers appellate procedure in the Courts from unfavorable Patent Office decisions. Chapters XV and XVI cover the three methods of correcting a patent after its issuance; namely, certificates of correction, disclaimers and reissues.

In conclusion the reviewer wishes to state that he is particularly impressed with the care, the attention to detail and the thoroughness with which the author has done his work. The concept and scheme of development are excellent and a very carefully prepared index renders the entire contents of the book instantly accessible.

Construction Figures

The consecutive monthly gains in construction contracts recorded since July, 1933 were continued into December quite ignoring the seasonal tendencies customary during the period. The contract total reported in December covering the 37 Eastern States amounted to $207,209,500; this was an increase of approximately 28 per cent over the November total which itself registered a gain of almost 12 per cent over October. In fact the total for the final month of 1933 was larger than that recorded for any other month since October, 1931 and was more than 2½ times as large as the contract volume recorded for December, 1932.

Of the December contract total $155,862,800 was for publicly-financed construction while the remaining total of $51,346,700 was for privately-financed undertakings. Publicly-financed construction contracts during December were almost nine times as large as the total for this class of work shown during April when such construction contracts were at their lowest point. Privately-financed contracts let during December were higher than for any month since April, 1932 with but four exceptions during the summer of 1933.

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range all the way from atomic weights to the speeds of pulleys, so that there is a fair chance of almost anything that might be required in the workshop being explained somewhere in the contents of this book. Perhaps the author has been a little too ambitious in roving over such a wide field, which is a good deal wider even than the outline given above.

So far as a preliminary examination of the book goes, the treatment seems good, although too condensed to be of any great value. Most users will prefer to go to treatises covering each phase of the subject a little more thoroughly.

The most annoying thing about the book is the interleaving with the text of thick paper pages containing advertising matter. This is something like the cheap and nasty telephone directories in some towns in the United States. When these pages are torn out the book becomes very much easier to handle. It is to be hoped that in future editions the author will leave them out in the first instance, and not impose on us the necessity of tearing them out.

*The term "Agenda" is regularly used in England, and but rarely in America, where responsible newspapers who ought to know better have described it as "stilted" and "highbrow". Agenda is simply Latin for "things that should be done". A list of matters upon which a board meeting is required to take action is described as the agenda, and in England the term is used almost entirely in connection with board meetings and meetings of stockholders.

In French, the term still means things that should be attended to or done, but can be used for things requiring the attention of individuals rather than of formal meetings.

F. W. PRESTON

Administration Option Added

The Department of Ceramic Engineering at the University of Illinois has added an Administration Option to its regular Ceramic Engineering curriculum.

This option is the result of requests both from the industry and from students who appreciate the need for men in the ceramic industry who have both commercial and technical training.

The option begins with the third year of University work, and includes such options as Economics, Industrial Organization and Management, Business Letter Writing, Marketing, Money Credit and Banking, Salesmanship, Accounting, Management in Manufacture, Personnel Administration, Corporation Management and Marketing Policies.

It is expected that those students planning to go into administration or sales work will select this option.

December Plate Glass Production

The production of polished plate glass by the member companies of the Plate Glass Manufacturers of America as reported by Secretary P. A. Hughes, for the month of December 1933 was 6,346,645 sq. ft., as compared to 4,169,442 sq. ft. produced by the same companies in the preceding month, November 1933, and 4,267,809 sq. ft. produced by the Association members in the corresponding month last year, December 1932.

This makes a total of 86,037,805 sq. ft. produced by these companies during the year 1933 as compared to a total of 52,221,635 sq. ft. produced by all companies during the preceding year, 1932.

Research on Frits and Enameling at Mellon Institute

Dr. Edward R. Weidlein, director, Mellon Institute of Industrial Research, Pittsburgh, Pa., has announced that the O. Hommel Company, of Pittsburgh, has founded an Industrial Fellowship in the Institute for the purpose of conducting scientific research on problems of enamel technology. In particular, it is expected that this Fellowship will acquire technical information, through its investigations in the laboratory and in plants, supplemented by the experience of specialists in the Hommel and cooperating organizations, that will enable it to serve as a clearing-house of dependable facts regarding frits and their industrial use. Research of the Fellowship will be published for the benefit of enamelers; and advice and information on enameling, and assistance in solving plant problems and in making evaluations or other practical tests of frits, will be extended gratis to companies that wish such technical aid.

The applications of the frits produced by the Hommel Company will be studied extensively, and any problems that are encountered in their use will be investigated thoroughly by the Fellowship. It is hoped by this donor that the new knowledge that will result from this work and from the other activities of the Fellowship will advance scientifically both frit production and enameling practice.

Steuben Glass Has New Headquarters

Making available the first center in metropolitan New York devoted exclusively to American art glass, Steuben Glass, Inc., is opening new headquarters in the Plaza section of upper Fifth Avenue. The opening date is February 19th, but special previews will be held in advance of the business opening. The new galleries or exhibition rooms will be devoted exclusively to art glass, of the hand-made variety, hand-made stemware, and architectural glass. It is distinctly an American contribution having been developed at Corning, New York.

The new galleries, will be under the direction of Mr. John M. Gates, New York artist and architect. Recently celebrated as a winner of an architectural prize for replanning the business and shipping center of Stockholm, Sweden, Mr. Gates has specialized in American art glass as a versatile medium for artistic and architectural expression. As director of Steuben Glass, in New York, Mr. Gates will be assisted by a staff experienced in the fine arts, and familiar with the technique of fine glass. The personnel will specialize in coordinating glass craftsmanship with service needs and preferences of individuals and organizations making selections from among the objects on display or who seek the execution of original designs. Significant in many respects, the opening of the salon can do much to advance the world position of America in its field of the fine arts.

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the section depicting the furnace and a narrow Saracenic border outlines the panel. The panel has been framed and is on display in 305 Thaw Hall, University of Pittsburgh, where the glass collection is housed. The undertaking was the result of Professor Silverman's efforts to encourage the application of art in the American glass industry.

Experiments have been made recently by the Bureau of Standards, Washington with the use of domestic soda salts instead of imported potash salt in the production of optical glass with indications that the material will be satisfactory. Glass produced with the aid of soda salts heretofore has lacked durability, it was claimed. Weathering tests will be made on the glass to determine its quality in this respect

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Glasscraft Manufacturing Company, 920 Chicago Avenue, Evanston, Illinois, has been organized with capital of 100 shares of stock, no par value, to produce glass specialties. David B. Schwartz and P. G. Garfinkle are the incorporators.

Libbey Glass Mfg. Co., Toledo, Ohio, manufacturer of table glassware has taken over the plant of the H. C. Fry Glass Co., Rochester, Pa. They plan to remodel and improve the plant and soon will be in readiness to produce stemware and tumblers.

With the recent addition of 1,060 employes at the plants of the Libbey-Owens-Ford Glass Company in Toledo, Ohio, Charleston, West Virginia, Ottawa, Illinois and Shreveport, Louisiana, a new all-time employment record has been established for the company. The total working force is now in excess of 5,000, an increase of 86% over the employment total of a year ago.

The company reports that their largest automobile customers are cooperating by placing their glass orders further ahead than heretofore.

Estimated earnings during 1933 for the Lynch Corporation, glass machinery builders at Anderson, Ind., approximate $3 a share, it was announced by officials of the company. The profit is the result of operations in the last eight months of the year and represents a sharp increase over 1932. The $3 dividend compares with one of 31 cents a share for 1932.

Libbey-Owens-Ford Glass Company's Rossford plant is erecting a new storage warehouse at a cost of $250,000.

This new building will provide for a very large storage of plate glass blanks which will give added protection to customers and steady employment of workers will be insured since it calls for the continuous operation of the company's glass furnaces.

The Standard Glass & Paint Company, Des Moines, Iowa is expanding its Iowa territory and has just opened a new distributing branch at 1441 Rockingham Road, Davenport Iowa. The firm also maintains branches in Fort Dodge and Waterloo.

Orders received by the General Electric Company during the year 1933 amounted to $142,770,791 compared with $121,725,772 for 1932, an increase of 17 per cent.

Orders for the quarter ended December 31 amounted to $37,985,790, compared with $27,351,658 for the last quarter of 1932, an increase of 39 per cent.

The American Potash & Chemical Corporation, New York has appointed the O. Hommel Co., Inc., 209 Fourth Avenue, Pittsburgh, Pa. as agent in western Pennsylvania, West Virginia and Ohio, for the sale of its well-known borax and boric acid.

The Board of Directors of the American Cyanamid Company on January 9 declared, out of its net earnings for 1933, a special dividend of twenty-five cents per share, payable on February 1, 1934 to holders of its class "A" and class "B" shares of record at the close of business on January 19, 1934. This distribution it is announced is to be regarded only as a return to the stockholders out of the earnings for 1933, and not the establishment of a dividend basis or policy for the future.

The Toledo Engineering Company, Toledo, Ohio has added Mr. P. Q. Williams to their staff of engineers. Mr. Williams had been research engineer of the Surface Combustion Company, and resigned his position there to carry on his work in the Toledo Engineering Company's laboratories.

The Hazel-Atlas Glass Company has made Mr. A. M. Algeo vice-president and special sales representative, it was announced, January 30. Mr. Algeo for the past nine years had been district manager for the Pennsylvania operations of the company with headquarters at Washington, Pa.

Mr. Samuel B. Bowman is now general factories manager in charge of operation and production in all 11 units of the company. Previous to this time, Mr. Bowman had been in charge of factories outside of Pennsylvania and West Virginia with headquarters at Zanesville, Ohio.

The staffs of the Washington units held an informal farewell meeting in the Hazel No. 1 plant on January 27 in honor of Mr. Algeo. They presented him with a matched white gold watch, chain and knife on behalf of the workers.

Louie Glass Company, Weston, W. Va. reports that for the first time since its organization five tanks are in operation. Orders now on hand at this plant assure a steady run for at least 90 days and the business outlook for the coming year is very promising.

Edwin C. Bowers

Edwin C. Bowers, manager of the Rossford plant of the Libby-Owens-Ford Glass Company died January 31 at the age of 71.

George Kraatz

George L. Kraatz, president of the Marion Glass Mfg. Co., Marion, Ohio, cutters and decorators of glassware, died in a hospital at Columbus, Ohio on January 25.

PRODUCTION MANAGER

Wanted: A position as factory or production manager in a bottle factory by a man who knows how to get results. Address "Classified J1".

Current Prices of Glass-Making Materials

as of Jan. 24, 1934.

Quotations furnished by various producers, manufacturers and dealers

Acid		Carlots	Less Carlots
Citric (dom.)	lb.	...	.29
Hydrochloric (HCl) 20° tanks	Per 100 lb.	...	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	...	.13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext.	Per 100 lb.	5.50	...
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	...
Tartaric	lb.	... Po. or Gr. .23 / Cry. .25½	
Alcohol, denatured	gal.	...	...
Aluminum hydrate ($Al(OH)_3$)	lb.	.04-.04½	.04½-.05
Aluminum oxide (Al_2O_3)	lb.	.04	.05
Ammonium bifluoride (NH_4FHF)	lb.	...	15¼
Ammonia water (NH_4OH) 26° drums	lb.	...	.02¾
Antimony, metallic (Sb)	lb.	.02½	.02¾
Antimony oxide (Sb_2O_3)	lb.	.08	.08½
Antimony sulphide (Sb_2S_3)	lb.	...	.07
Arsenic trioxide (As_2O_3) (dense white) 99%	lb.	.04	.04½
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	56.50	61.50
90% through 100 mesh	ton	44.00	...
Barium hydrate ($Ba(OH)_2$)	lb.	..	.05¾
Barium mixture, glassmaker's, f. o. b. St. Louis	ton	25.00	...
Barium nitrate ($Ba(NO_3)_2$)	lb.	...	.08½
Barium selenite ($BaSeO_3$)	lb.	...	...
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point	ton	15.00-16.00	18.00
Bone ash, carlots	lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	...	...
Granulated	In bags, lb.	.02	.02¼-.02½
Powdered	In bags, lb.	.02¼	.02½-.02¾
Boric acid (H_3BO_3)	In bags, lb.	.04¼	.04½-.04¾
Cadmium sulphide (CdS)—			
Red	lb.	...	.75-.85
Orange	lb.	..	.70-.75
Yellow	lb.	...	1.30-1.50
Chromium oxide (Cr_2O_3)	lb.	..	.22
Cobalt oxide (Co_2O_3)			
In bbls	lb	.	1.25
In 10 lb. tins	lb.	...	1.35
Copper oxide			
Red (Cu_2O)	lb.	...	.25
Black (CuO)	lb.	...	.17-.19
Black prepared	lb.	..	.22
Cryolite ($Na_3Al\ F_6$) Natural Greenland (Kryolith)	lb.	.08½	.09
Synthetic (Artificial)	lb.	...	.08
Epsom salts ($MgSO_4$) (imported) technical	Per 100 lb.	...	2.40
Feldspar—			
40 mesh	ton	10.00-11.50	
20 mesh	ton	10.00-11.50	
Granular	ton	10.00-12.00	
Semi-granular	ton	10.00-11.50	
L. C. L., (Min. 2 tons) $2.00 per ton additional plus charge for bags			
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%)			
Bulk, carloads, f. o. b. mines	ton	30.00	
In bags or barrels	ton	34.00	36.00
Imported	ton		
Formaldehyde	lb.	...	.07
Graphite (C)	lb.	...	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	.	.0425
Black (FeO)	lb.	.04½	...
Kaolin (f. o. b. mine)	ton	8.00-9.00	...
English, lump, f. o. b. New York	ton	14.50-25.00	24.50-30.00

Kryolith (see Cryolite)		Carlots	Less Carlots
Lead chromate ($PbCrO_4$)	lb.	...	.30
Lead oxide (Pb_3O_4) (red lead)	lb.	.0650	.0775
Litharge (PbO)	lb.	.0550	.0675
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	10.50	...
Burnt (CaO) ground, in bulk	ton	7.00	...
Burnt, ground, in paper sacks	ton	9.00	
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	2.30
Limestone ($CaCO_3$)		1.50-2.50	...
Magnesia (MgO)—			
Calcined, heavy (in bbls)	lb.	.06	.07
light (in bbls)	lb.	...	.23
extra light (in bbls.)	lb.	...	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.10
Manganese 85% (MnO_2)	lb.	57.50	62.50
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	...	.35
Nickel monoxide (NiO), green— for nickel content	lb.	...	.35
Plaster of Paris, bags	ton	31.00	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.08½	.08¾
Powdered	lb.	.08¾	.09⅛
Potassium carbonate	lb.	.0825	.0875
Calcined (K_2CO_3) 96-98%	lb.		
Hydrated 80-85%	lb.	.07¼	.0775
Potassium chromate (K_2CrO_4)	lb.	..	.14½
Potassium hydrate (KOH) (caustic potash)	lb.	.07½	.09
Potassium nitrate (KNO_3) (gran.)	lb.	...	.06-.06¼
Potassium permanganate ($KMnO_4$)	lb.	.18½	.19
Powdered blue	lb.	...	.23
Rochelle salts, bbls	lb.	..	.12½
Rouge	lb.	... Po. or Gr. .13½ / Cry.	
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	18.00	...
Selenium (Se)	lb.	...	1.80
Silver nitrate (AgNO)	(100 oz.) per oz.	...	.31
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat Per 100 lb.	1.10	...
In barrels	Per 100 lb.	1.50	...
In bags	Per 100 lb.	1.25	...
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06½	.06¾
Sodium hydrate (NaOH) (caustic soda) Solid	Per 100 lb.	2.60	...
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls	lb.	...	3.62
95 per cent	Per 100 lb.	1.195-1.295	1.245-1.345
Sodium selenite (Na_2SeO_3)	lb.	...	2.00
Sodium fluosilicate (Na_2SiF_6)	lb.	.04¼	.05-.06
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	...	1.50-1.55
Sulphur (S)—			
Flowers, in bbls	Per 100 lb.	3.45	3.70-4.05
Flowers, in bags	Per 100 lb.	3.10	3.35-3.65
Flour, heavy, in bbls	Per 100 lb.	2.85	3.20-3.45
Tin chloride ($SnCl_2$) (crystals)	lb.	.38	.38½
Tin oxide (SnO_2) in bbls	lb.	...	.58
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	...	2.75
Yellow orange	lb.	...	1.50
Zinc oxide (ZnO)	lb.	.08½	.12
American process, Bags	lb.	.05¾	.06
Zircon			
Granular (Milled .005-.02c higher)		.07	.67½-.08
Crude, Gran. (Milled .005-.02c higher)		.03½	.04-.05